Exhibit # MH-113

Attached are ICF's responses to questions asked by Drs. Kubursi and Magee through their Counsel, Mr. Gavin Wood.

Confidential and Privileged

Responses to Questions from Dr. Atif Kubursi and Dr. Lonnie Magee

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Responses to Questions from Dr. Atif Kubursi and Dr. Lonnie Magee

Question 1. With Respect to Ex. 55. p.61:

(a) Why is it not necessary to take the variation in these other variables into account when examining the financial consequences of a drought?

(b) Why is there less reason to examine multiple risk events when an event is less common?

Response: The critical issue in determining the stringency of financial stress tests are (1) the rarity (or probability) of occurrence, (2) the magnitude, and (3) the costs of managing the event tested. The issue regarding the number of variables used in a stress test is irrelevant per se, but rather the relevant issue is how stringent should the stress test be (in terms of its impact, and likelihood)?

As a general matter, the magnitude of an adverse event is inversely correlated with its probability. For example, in the economic sphere, the most extreme/severe economic event is also the rarest one – the Great Depression occurred only once. In the case of earthquakes, the most severe in history is also the rarest. Similarly, in the case of MH hydrological conditions, the most extreme/severe event in the historical record is the seven year drought, which also only occurred once.

The probability of an already less common event occurring with other risk factors is extremely low, and hence, even if the magnitude of the resulting impact may be high, such an extreme event is not generally stress tested. Companies are not stress tested to see how they would perform financially if the Great Depression were repeated (leave alone combining such an event with other risk factors). In general, they are tested against events that are more common and less stringent – like credit rating downgrades, and average recessions. This is because the cost of protection against extremely severe and rare events can be excessive compared to the benefit. Similarly, in earthquake prone areas, buildings are designed to remain inhabitable for once in 50-100 year events (likely to occur during the lifetime of the building), not the worst earthquake on record in world history. By the same token, for MH it is cost prohibitive, and also not informative, to examine events so catastrophic and so unlikely (such as a severe prolonged drought together with other risk events) that no risk management strategy can be reasonably employed. There can be no expectation that MH should plan for such an event. As discussed in a subsequent response, it is proper to have reasonable quantitative stress tests and qualitative considerations when quantification is not possible.

Moreover, unlike MH, the other companies facing financial stress tests (e.g. banks) generally do not have franchised service territories with the ability to raise rates without significantly losing customers. Rather, other companies subject to financial stress tests lose most, if not all, of their customers if they significantly raise rates/prices and they are bankrupted and liquidated. Their costs of recovering are also higher than for MH which

has a franchised service territory, the ability to raise rates and revenues, and the backing of the Province. Given these considerations, the stress tests for MH should not be more stressful than those for other companies.[1]

The biggest threat facing MH is a prolonged drought. At any point, the relevant issue is, given that the Corporation is not in a prolonged drought at that point, what is the chance of entering one and what would be the consequences. The stress test chosen by MH is the second worst prolonged drought in recorded history. In 97 years, this drought, or a worse prolonged drought has happened only twice. That is, there are only two years in the recorded history of the Corporation that were the start of prolonged droughts equal to or worse than the one chosen. Thus, there is only a 2 percent chance of an outcome that stressful or worse (the 3 percent chance mentioned in the ICF report is associated with being at the start of any 5 or 7 year drought). This stressful rare event chosen by MH is as stressful as other stress tests reviewed (in that they were the main risk that the company was expected to withstand, and the likelihood of the risk was similar).[2] Adding more variables[3] to the stress event considered by MH makes the event less likely, and too stressful.[4]

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[1] "[I]f MH finds itself in a drought, the Corporation can borrow money and/or raise rates more easily than most entities being subject to stress tests. Thus, considerations of the extremity of the stress test and the potential for recapitalization once the chance of equity problems occur, supports the view that stress testing for an event with less than 3 percent chance is too stressful." ICF report, p.22.
"The degree of stress should be related to the consequences. In the event that the Corporation's retained earnings decrease by even more than $2.7 billion, Manitoba Hydro has the ability to increase capital at fairly low cost compared to other organizations. This is because of lack of competition in the domestic market combined with provincial financial backing. Thus, its base line quantification should not be a 99 percent confidence interval since it could result in over-insurance, e.g., even higher retained earnings." ICF report 114.

[2] "The assessment of the stressfulness is based on the review of: (1) general approaches to characterizing financial risks such as the choice of confidence intervals, (2) the interaction of drought with other risk events such as high wholesale power prices, (3) starting point of adverse event, (4) availability of mitigation strategies, (5) duration of adverse event, and, (6) a comparison of Manitoba Hydro's quantification of risks with those of other organizations." ICF report, p.108. "The stringency is comparable to other stress tests – S&P liquidity test; U.S. bank stress test; these organizations have less recovery potential." Rose presentation, p.61.

[3] As long as they are random variables with both exacerbating and ameliorating outcomes.

[4] "Another consideration is whether any other risk should also be jointly considered during the quantification of an extended drought. The largest concern is the potential for a combination of drought and high prices for wholesale power. This would increase the cost of purchases to meet firm sales commitments. Other events could also occur including higher interest rates, higher construction costs, etc. Thus, in determining how stressful Manitoba Hydro's main stress test should be, one must consider the extent to which the occurrence of risk events should be combined. In Manitoba Hydro's case, the problem is that examination of almost any additional variable lowers the probability to beyond the 95 percent confidence interval. If one were to combine the occurrence of an extended drought with treating electricity prices as uncertain (for example, instead of assuming the Base Case price is fixed, one could examine high and low price scenarios, each with 50 percent chance, such that the expected price is the same), it would further decrease the probability that this extreme stress case would actually occur to approximately 1.5 percent, i.e., there would be only a 1.5 percent probability of drought and high prices. This is below the 95 percentage confidence level and close to the 99 percent confidence interval. We believe that such a case would be too stressful for a baseline stress test". ICF report, p.113.
"We observe that some other financial stress tests involve more than one risk factor changing simultaneously while Manitoba Hydro's does not. However, these organizations examine more common events than extended

However, once the Corporation *is* in a drought, the chance of a prolonged drought increases. Therefore, in order to stress test the Corporation with the same level of confidence, other variables need to be considered in such a situation. This approach is as recommended in the ICF report.[5]

droughts, for example, recessions. Hence, they need to examine a broader range of events, including simultaneous changes in more than one variable in order, to reach the confidence levels that Manitoba Hydro reaches when varying only one variable, i.e., is there an extended drought or not. Hence, as a general matter, Manitoba Hydro does not need to simultaneously examine multiple risk events." ICF report, p.109.

[5] "The nature of the stress test may need to change depending on circumstances, especially the starting point. For example, once it is clear that Manitoba Hydro is in the second year of below average water conditions, there is a 1 in 8 or 12.5 percent chance that it faces an additional five years of drought. In such a situation, it may be more appropriate to explore a combination of events – e.g., a five year drought and unexpectedly high power prices." ICF report, p.114

"While the quantification approach is reasonable, once in a drought, quantification using multiple variables may be reasonable (e.g., Monte Carlo simulation of cash flow at risk using a PRISM IFF combination) in part to better track risks and to facilitate communication across the company and with stakeholders regarding the progress of the drought and the likely financial impacts of the Drought Preparedness Plan. This would build on on-going PRISM work and also facilitate additional examination of short-term (1-2 years forward) hedging tools. Also, some additional examination of the consequences of depleting retained earnings would be useful in terms of impact on rates." Rose presentation, p.65.

Question 2. With Respect to Ex. 55. p.62:

(a) In what sense is this particular 'distribution' of power prices based on an analysis of actual power prices? Why is it that ICF takes only higher or lower prices as the only two possibilities?

Response: ICF does not present a probability distribution for future prices. It presents historical prices and the first two moments of the historical distribution – i.e., the mean and the standard deviation. The company has a confidential estimate of the first moment of the future price distribution based on forecasts from multiple entities. It was not within ICF's scope to create distributions, and not necessary when reviewing the Corporation's already very stringent financial stress case in its Integrated Financial Forecast ("IFF").

However, the historical record is instructive. The single worst year in terms of high power prices had all-hours prices that were 66 percent above the average, and the worst consecutive three years had prices 51 percent above the average. In contrast, the increase in annual imports and wind purchases in a representative extended drought year was 177 percent, the decrease in exports was 50 percent, and the increase in MH thermal generation was 1852 percent.[6] Thus, from a financial impact perspective, uncertainty in the quantity of MH hydro power, and not the price, is the critical and most stressful factor. I return to this issue in a later response.

Separately, the only possibilities for prices are higher or lower than the expected value.

(b) Are these "low" and "high" power prices arbitrarily chosen, and are their 50% probabilities also arbitrarily assigned?

Response: The probabilities are not "arbitrarily assigned", but shown illustratively to highlight the increasingly unlikely, and hence, stringent nature of creating a case with high power prices plus hydraulic stress. As discussed in the ICF report, such a scenario would result in a test that is too stressful.[7]

[6] See Rose presentation, p.58.

[7] "Another consideration is whether any other risk should also be jointly considered during the quantification of an extended drought. The largest concern is the potential for a combination of drought and high prices for wholesale power. This would increase the cost of purchases to meet firm sales commitments. Other events could also occur including higher interest rates, higher construction costs, etc. Thus, in determining how stressful Manitoba Hydro's main stress test should be, one must consider the extent to which the occurrence of risk events should be combined. In Manitoba Hydro's case, the problem is that examination of almost any additional variable lowers the probability to beyond the 95 percent confidence interval. If one were to combine the occurrence of an extended drought with treating electricity prices as uncertain (for example, instead of assuming the Base Case price is fixed, one could examine high and low price scenarios, each with 50 percent chance, such that the expected price is the same), it would further decrease the probability that this extreme stress case would actually occur to approximately 1.5 percent, i.e., there would be only a 1.5 percent probability of drought and high prices. This is below the 95 percentage confidence level and close to the 99 percent confidence interval. We believe that such a case would be too stressful for a baseline stress test." See ICF report, pp.113-114.

(c) If "yes" in (b), then the "equivalent confidence intervals" in the table are based on arbitrarily assigned probabilities, rather than on a statistical data analysis. What meaning should KM place on these arbitrarily assigned "confidence intervals"?

Response: N.A.

(d) Also, in this example there are two variables, the second being energy price. This has implications for how to interpret the confidence level and interval (e.g., stats books show 2-dimensional "confidence ellipses" rather than confidence intervals when there are two variables). It appears that ICF has used joint probabilities to get the confidence level, but used the conditional distribution (given price) to get the interval itself. This appears to be a contradiction. Can ICF refer to a textbook or other source to justify this procedure?

Response: ICF was illustrating the necessary effect of adding more variables to the stress case -- i.e., addition of other variables to a prolonged drought resulting in an unrealistic and overly stringent stress test with a lower probability confidence interval. It should be noted that the stress case considered by MH assumes zero domestic rate increases (beyond the base case), and hence, can be implicitly considered to already include another variable. There are other stringencies in the stress scenario as well, such as no reduction in other costs.[8]

Separately, if ICF were to explore price uncertainty, it would most likely recommend a Monte Carlo approach. Hence, the continued development of the PRISM model is considered to be important.

[8] "Under this methodology of assessment of the impact of an extended drought, expected market conditions were assumed for thermal and import costs as well as for other parameters of the models. Also, the consequences were examined assuming no adjustment to the base case domestic electricity rates." ICF report, p.109

Question 3. With Respect to Ex. 55, p.68:

P.111 of the original ICF report states: "Manitoba Hydro is sensitive to the fact that ... the Corporation faces the risk of droughts of potentially even longer duration or greater severity than those experienced since hydrological records have been maintained ... ".

(i) Given this fact, why does ICF advocate an approach that does not allow for this possibility?

Response: Black Swan events should be considered in a company's risk management strategy; they are the biggest challenge identified in the risk management literature.[9] Indeed, ICF advocates preparation for Black Swan events.[10] Such preparation is especially relevant when there are strategies that can be adopted to provide numerous large benefits. There is a mention of Black Swan events (droughts worse than the worst on record) on average every 4 pages in a long report.

It is proper to have reasonable quantitative stress tests and qualitative considerations when quantification is not possible. MH's risk management strategy correctly incorporates Black Swan events in a qualitative manner (i.e., planning for a drought worse than the worst on record).[11] In this regard, the definition of a Black Swan event is one in which no quantitative estimate can be made (since the entire range of hydrological possibility is not known). Europeans had never seen swans that were not white till they arrived in Australia, and no conjectures regarding the existence of black swans could be quantitatively tested. The recent catastrophic earthquake in Japan also underscores this point. Reliance on even 300 years of past data could not predict the enormity of the recent earthquake (see below).

> *What is perhaps most surprising about the Japan earthquake is how misleading history can be. In the past 300 years, no earthquake nearly that large – nothing larger than magnitude-eight – had struck in the Japan subduction zone. That, in turn, led to assumptions about how large a tsunami might strike the coast.*
>
> *"It did them a giant disservice" said Dr. Stein of the geological survey. That is not the first time that the earthquake potential of a fault has been underestimated.*

[9] "Given the adverse consequences of an event worse than has ever been recorded or seen, Manitoba Hydro is wise to consider Black Swan events and plan for it as it has done." ICF report, p.113.

[10] "[T]he essence of the Black Swan event is -- is that [MH needs to] have import capability or some other source of power to withstand an extreme drought." Rose testimony, p.2735

[11] "[A]n unprecedentedly severe drought, without more transmission or non-hydro supply, creates a Black Swan Risk. The company's export policy serves as a mitigation strategy to this risk" ICF report, p.23.
"Manitoba Hydro currently has limited import capability. If the Province were to experience a drought outside the historical record, domestic supply could be threatened. In the extreme, this could be catastrophic, especially during the winter. As noted in an earlier chapter, this is a "black swan" event – i.e., an event of low and unknown probability, but with a large consequence. The most notable risk management failures often involve decision makers not adequately preparing for these black swan events. However, almost ironically, export contracts are the key to getting more access to imports in the event of an emergency as discussed elsewhere. Thus, the binding terms sheets negotiated by MH with the three U.S. utilities help the Corporation address this risk." ICF report, p.125

Most geophysicists did not think the Sumatra fault could generate a magnitude-9.1 earthquake, and a magnitude-7.3 earthquake in Landers, California, in 1992 also caught earthquake experts by surprise.

"Perhaps the message is we should re-evaluate the occurrence of super-large earthquakes on any fault," Dr. Stein said.

Source: Quake Moves Japan Closer to U.S. and Alters Earth's Spin, The New York Times International, March 14, 2011, p. A8

ICF objects to attempting to quantitatively answering a question which cannot be quantitatively answered until more data is available. The KM approach is an interesting conjecture, not an estimate useful for prudent company decision making. It provides a false sense of knowledge about the future that could undermine MH's efforts to secure the Corporation from these events by inadvertently under-estimating the threat.[12]

(ii) Why does ICF base the probability of occurrence of a drought on the probability of entering a drought in any given year?

Response: ICF believes that the proper case to consider for all years in which the Corporation is not currently in a drought, is to examine the chance of entering one. MH is not currently in a drought. This issue is discussed further below. See ICF report for recommendations for other cases – i.e., when MH is already in a drought.[13]

(iii) Would not the probability of experiencing a drought in any given year be more meaningful? (There were 17 years of extended drought (5 + 5 + 7) in the 97-year period. The

[12] Put another way, ICF believes that a precise estimate of a drought worse than the worst on record – such as "[w]hile a more severe drought than the one experienced in 1937-1942 is possible, its probability of occurrence is 24 times in 9400 years" (Manitoba Hydro Risks: An Independent Review, Kubursi and Magee, November 15, 2010 ("KM report"), p. xxxii) is misleading. We believe that "[w]hile quantification is a good discipline, judgment also has to be used – i.e., the right balance has to be found. Models are useful and their absence would be a concern, but it is dangerous if overly relied upon by decision-makers." Rose presentation, p.65.

[13] "The nature of the stress test may need to change depending on circumstances, especially the starting point. For example, once it is clear that Manitoba Hydro is in the second year of below average water conditions, there is a 1 in 8 or 12.5 percent chance that it faces an additional five years of drought. In such a situation, it may be more appropriate to explore a combination of events – e.g., a five year drought and unexpectedly high power prices, e.g., a 25th percentile price on average during the five year period." ICF report, p.114.

"While the quantification approach is reasonable, once in a drought, quantification using multiple variables may be reasonable (e.g., Monte Carlo simulation of cash flow at risk using a PRISM IFF combination) in part to better track risks and to facilitate communication across the company and with stakeholders regarding the progress of the drought and the likely financial impacts of the Drought Preparedness Plan. This would build on on-going PRISM work and also facilitate additional examination of short-term (1-2 years forward) hedging tools. Also, some additional examination of the consequences of depleting retained earnings would be useful in terms of impact on rates." Rose presentation, p.65.

probability of experiencing an extended drought in any given year is 17/97 = 17.5%, which obviously is much higher than the 3.1% probability of entering an extended drought in any given year.)

Response: The event suggested in the question ("experiencing an extended drought") is a far less stressful event than the one considered in the ICF report (that of being in the first year of an extended drought of five years or more). The expected remaining duration of drought in *any* given year of a prolonged drought is given by 17 divided by 3, divided by 2, (since on average a prolonged drought lasts 17/3 years, and in any given drought year the average remaining duration is half the length of the prolonged drought). That is, the expected remaining duration of drought in *any* given year of a prolonged drought is less than 3 years. While the two events are not directly comparable, in the ICF report we have considered a more stressful case – that of a drought lasting 5 or more years.

Separately, in the scenario considered above, if one wanted to explore what would happen in the remaining three years if one had already been in a prolonged drought, one would be back to the approach discussed in the ICF report. Further, it is clear that the chance of this happening is not 17.5 percent, but 2-3 percent.

It is worthwhile to emphasize that the main threat facing MH is a prolonged drought spanning more than 3 years, and as discussed previously, the Corporation has chosen an appropriately stressful case. As discussed in a previous response, the range of power price outcomes is too narrow to have the 17.5 percent chance referred to in the question (with expected remaining drought of less than 3 years) combine with high power prices to create as much financial stress as the effect of the second worst prolonged drought and the resulting loss of hydro production.

Even if there was an expectation of creating a series of combinations of shorter droughts and market conditions that matched the stressfulness of prolonged droughts, this is not possible. This is because a prolonged drought creates a possibility that a combination of high prices and short droughts do not – a possibility of failure to serve domestic load. The consequences of such an eventuality are not only very high financially, but are qualitatively very different from the financial consequences of having to purchase power at an elevated price. Unserved energy costs in Manitoba are huge, especially during the winter peak season and greatly in excess of any market price. Also, the risks to the population are qualitatively different. This is another way of saying that a prolonged drought is and should be the stress case of greatest interest for the Corporation. The approach of emphasizing events that are not as consequential would also have the unintended consequence of diverting focus from the potential inability of MH to supply domestic load due to a lack of system toughness (resulting from a lack of transmission import capability).

(iv) Given that 17.5% of the years in the historical record were years that belonged to an extended drought episode, in what meaningful sense can one claim that "All evidence

supports the likelihood of a five year or greater drought being approximately 3 percent" as is claimed on p.68 of the 2011 ICF document?

Response: The issue is not being in a drought, but being in the beginning of a prolonged drought. See answer to previous question.

Question 4. With Respect to Ex. 55, p.78:

(a) MH has also been criticized for excessive use of deterministic modeling versus stochastic modeling. The development of PRISM addresses this concern.

(i) The development and use of PRISM is praised by KM. What KM are worried about is the integration of PRISM with HERMES and possibly SPLASH. Does ICF know of any use of PRISM results in HERMES and SPLASH?

Response: No; ICF is not aware of any use of PRISM results in HERMES and SPLASH.

(b) According to the KM report, the advantage of Quebec's and BC's hydro modeling is in the stochastic nature of their systems, which makes them more complex but perhaps more useful tools for risk management.

(i) Does risk management require in your opinion probabilistic models and stochastic variables rather than deterministic variables? If yes, then why is ICF criticizing KM for calling for this induction of probabilistic models?

Response: The criticism[14] is that while more modeling can be beneficial, each company has limited resources. In MH's case, the focus should be on the continued development of PRISM; there is no evidence of additional pressing stochastic needs. Also, it is common for customized modeling to examine multiple scenarios in the context of deterministic modeling, an approach that is also adopted by MH.

In ICF's view, it is first crucial to handle the existing quantitative information. There is an urgent need to consolidate understanding of the already available information on the part of the regulators and the process participants. This conclusion is based on the failure to appreciate the need to increase transmission capacity into the Province.[15] Also, there appears to be a failure to understand the challenge of obtaining U.S. transmission line construction while maintaining Canadian sovereignty, i.e., by not giving the Midwest Independent System Operator ("MISO") the authority to solve the transmission problem.

(ii) Does the use of PRISM suffice for dealing with risk management issues?
(iii) Would the use of stochastic variables in SPLASH and HERMES bring these models closer to risk management tools?

[14] This is related to KM's suggestion of having MOST, HERMES, and SPLASH "cast in a stochastic framework." KM Report, Chapter 3, pp.52-129. However, the "[c]ommon practice in the electric utility industry is to limit run times to avoid implementation failures … [one way this] problem is avoided by … [is the use of] a combination of deterministic models with multiple scenarios and stochastic models". See Rose presentation, p.73.

[15] "[Transmission] lines are crucial for securing firm import and export capability and may be difficult or impossible to get sited and constructed in the absence of the long-term contracts. They are also expensive if MH must build and pay for them with export contracts." Rose presentation, p.22

Response: I see no urgent problem needing an immediate solution.[16] MH has a risk management strategy and is improving its risk assessment capabilities by making expected improvements to PRISM.[17] I also understand the Corporation is making progress in quantifying Value at Risk ("VaR") of its portfolios. These improvements will equip MH and further enhance its capability to handle risk management issues.

(c) KM also advocates increased reliance on hydro modeling via synthetic as opposed to historical hydro flow data sets.

(i) How does KM generate the different sampling of 97 years using their stochastic mechanism? Is ICF suggesting that KM do not begin with the actual historical 97 water flows?

Response: ICF believes that the best approach is to use the sample consisting of the last 97 years of data, as has been done.

(ii) KM has generalized the historical data by looking at 1000s of possible 97 water flow series. Does this not enrich the data set and allow for the consideration of possible minima not in the historical 97 record but seem to be in the tree rings data?

(iii) What is ICF's concern on this method?

Response: This enrichment involves assumptions about the shape of the hydraulic distribution which are not well founded; they are conjectures about the future. The tails of the distribution may exhibit unexpected leptokurtosis for example, that is incompatible with the assumptions made and the problem might be worse than estimated. In this case, the assumption used -- i.e. no surprising leptokurtosis -- is not conservative; it is only making the problem seem less worse than it might be.

The paleo-climatic materials I reviewed (and have provided in a separate undertaking) and our other research show that the state of the science, both dendrochronologically and in terms of lake sediments, is such that the scientific community lacks the ability to provide quantification of the risk of a drought worse than the worst on record beyond the fact that it is possible.[18] Synthetic enrichment is more appropriate when the sample is much smaller, not when it is

[16] Currently MH uses the PRISM model to simulate the financial impact of variations in various parameters such as water flow conditions, domestic load, gas and electricity prices, export sales, transmission access, and wind energy generation. "PRISM is stochastic in nature which is more appropriate for risk management models. Risk management models, with the exclusion of capacity expansion, have simplified production costing treatments." Rose presentation, p.78.

[17] "MH is continuing to develop and enhance the capabilities of PRISM." Rose presentation, p.80.

[18] "MH has considered the use of paleo-climatic and other information to extend the historical record. However, broad-based research efforts within the scientific community have thus far failed to create the needed information for the modeling." Rose presentation, p.85. See also ICF report, p.111.

approaching 100 years.[19] At this point, the best enrichment is qualitative. The Corporation and regulators need a comprehensive program for toughening up MH's system to withstand a worse drought than the worst on record.

[19] KM assert that "[w]ater flow records have ***only*** been kept for the last 97 years." (emphasis added), KM report, p.131. On the contrary, "Manitoba Hydro is fortunate to have a large amount of data upon which to base its quantitative assessment of extended droughts. The Corporation bases its assessment of hydrological conditions on the 97 years of available hydrological information between 1912 and 2008. The analysis of most financial risks by most other organizations uses less data. Use of synthetic data is appropriate for organizations with much less data." Rose presentation, p.85. Also, MH streamflow record is excellent compared with other hydroelectric utilities in North America. See Rose presentation, pp.83-84.

Question 5. With Respect to Ex. 55, p.87:

(a) Does ICF want KM to accept that wind must be part of dependable energy when it is not dispatchable and when NERC does not include it in the reliability criteria?

Response: Yes, wind should be included as part of dependable energy.

(b) On what grounds would you argue that it should be included?

Response: The ample energy storage capability of the MH system and its need for energy makes typical NERC treatment of capacity in low storage systems inappropriate in the MH case (as discussed in my presentation).[20] Wind energy should be considered for reliability purposes.

[20] This issue is discussed in further detail in my presentation to the Board (excerpt provided below). Specifically, it addresses "KM' s view that when an energy resource cannot be dispatched such as wind, it would be difficult to rely upon it to meet dependable demand." MH/KM - 26 (IR)
ICF Response:
- "MH has sufficient real-time energy storage to avail itself of the reliability contribution of wind energy.
- In hydroelectric systems, reliability is not determined by meeting peak demand plus a reserve margin; the peak capacity constraint is rarely binding at system peak. Rather, hourly energy supply requirements are typically binding. The goal is to minimize costs/maximize profits subject to meeting binding hourly energy constraints.
- The capacity requirement approach can theoretically be used even for systems with energy producing non-dispatchable power plants like wind and hydro. This is done by adjusting the capacity contribution of the non-thermal elements finding the thermal capacity equivalent. Thus, there is no avoiding energy simulation. The less thermal the system, the less appropriate is a peak reserve margin approach because it gives a misleading impression that meeting peak demand is binding and sufficient to determine reliability.
- MH is using the right approach given its highly hydro-based system: it focuses on hourly energy requirements and it ignores wind resources in planning its capacity obligations." See Rose presentation, p.88

Question 6. With Respect to Ex. 55, p.87 concerning the thermal energy:

(a) Does ICF agree with KM that KM recognize the physical inclusion of thermal energy in dependable energy but raise the question about the viability of this induction when it is generally uneconomic to run thermal energy?

Response: Reliability should be kept separate from economic considerations. In the event that the thermal units' going-forward-costs do not exceed their benefits, and as long as economic dispatch is performed, they should not be shut down and their energy should be considered for reliability purposes.[21]

(b) Are KM not drawing a real and true distinction here between physical and economic availability? Why would ICF assume that KM is confusing the two when KM wants to raise the question about physical inclusion of a source when it is uneconomic to do so?

Response: KM have shown no evidence that during extreme hydrologic events, the use of the thermal units and their retention are uneconomic. It is simply noting their variable costs are high which explains their infrequent use.

[21] This issue is also discussed in the Rose presentation (excerpt provided below), and is in response to KM's suggestion that "when thermal energy resources are typically too expensive (and inefficient) and out of money, their inclusion in dependable energy is problematic." MH/KM - 26 (IR)
ICF response: "The only consideration for existing thermal is that they be kept on-line as long as it is economic to do so, i.e. that the going forward benefits outweigh the going forward costs. As long as such capacity is available for meeting reliability, this is largely an economic consideration." Rose presentation, p.89.

Question 7. With Respect to integration of the models, Ex. 55, p.99:

KM argue on P.99 of the KM Report that "SPLASH is and is not an extension of HERMES but the two need to be reconciled and situated on a common platform. At the moment they are not fully integrated. There is more room for linking explicitly the two systems to benefit from their commonalities. The real danger lies in the fact that they can and have produced different results. SPLASH results are more "optimistic" than those of HERMES. In some respects they impose different structures. For example, SPLASH fixes ending lake levels in its simulations to guarantee next period's firm requirements, in HERMES these are part of the optimal solution."

(a) What is wrong with this assessment?

Response: The concern is stated below.

(b) Are not there economies of scale and scope that can be derived from integrating and harmonizing the commonalities among these systems?

Response: ICF is pointing out that there are both economies and diseconomies of scale in consolidating models. The diseconomies arise from the specialized use and structure of the models, and the challenges of trying to have one model answer all questions.[22]

(c) Is it acceptable that the two systems do not use the same coefficients?

Response: The level of detail may require reduced forms in some cases. If, however, there are errors (e.g. the wrong reduced form representation), then this can be a problem.

(d) Are there any advantages to pool resources together to oversee and backstop these systems?

Response: See response to 7(b) above.

[22] According to KM, "HERMES, SPLASH and PRISM … can be expanded, harmonized, integrated and expanded." KM Report, p.xxx. However, the "[c]ommon practice in the electric utility industry is to limit run times to avoid implementation failures; excessive integration results in implementation failures. This problem is avoided by:

- Aligning models with decision timeframes, e.g., planning models for long-term investment decisions, short-term models for operations
- Aligning models with application – e.g., operations, planning, finance, detailed transmission
- Use a combination of deterministic models with multiple scenarios and stochastic models
- Use linear and non-linear optimization models/solution approaches such as Monte Carlo

See Rose presentation, p.73.

"[A]s computers are becoming more powerful, trend is to disaggregate more rather than fully integrating complex models". Rose presentation, p.77